

A comparative study of central versus posterior approach for internal jugular hemodialysis catheter insertion

M. Mathur, A. V. L. D'Souza, D. Prasad, R. Garsa, N. Bansal, R. Jhorawat, S. Sharma, P. Beniwal, D. Agrawal, V. Malhotra

Department of Nephrology, SMS Hospital and Medical College, Jaipur, Rajasthan, India

ABSTRACT

Internal jugular (IJ) catheter insertion for hemodialysis (HD) is an indispensable procedure in the management of patients with renal failure. The central approach is favored over posterior approach to insert IJ catheters. There are no studies comparing the outcomes between the two approaches. The aim of this study was to compare central approach with posterior approach for IJ HD catheter insertion and to analyze various outcomes like procedure-related complication rates, catheter insertion failure rates, interruptions during dialysis due to blood flow obstruction and catheter infection rates between the two methods among patients receiving HD. All patients requiring IJ HD catheter insertion during a 1-month period were randomly assigned to undergo catheter insertion via either conventional central approach or posterior approach. Patients were followed-up till the removal of the catheter. Among 104 patients included in the study, 54 were assigned to the central approach group and 50 to the posterior approach group. The central approach group had higher rate of procedure-related complications (14.81% vs. 6%, $P = 0.04$). Catheter insertion failure rates were marginally higher in posterior approach group (20% vs. 12.96%, $P = 0.07$). One or more instance of interruption during HD due to obstruction in blood flow was more common in posterior approach (46% vs. 9.25%, $P < 0.01$). Catheter infection rates were similar between the two groups; 16.66% ($n = 9$) in central group vs. 14% ($n = 7$) in posterior group. Posterior approach is a reasonable alternative to conventional central approach in IJ cannulation for HD catheter. It is, however, associated with a significantly high rate of interruption in HD blood flow and catheter insertion failure rates. The posterior approach can be used in patients with local exit site infection or in failed attempts to cannulate IJ vein via the conventional central approach.

Key words: Central approach, hemodialysis, internal jugular catheter, posterior approach

Introduction

Ever since the development of extra-corporeal techniques of dialysis, vascular access has remained the Achilles heel in effective management of patients with renal failure. There have been significant improvements in equipment, techniques and outcomes. Various innovations like use of PTFE catheters, ultrasound-guided hemodialysis (HD)

catheter insertions and tunneled HD catheter insertions have become commonplace.

Among various techniques for internal jugular (IJ) HD catheter placement, central approach is the most commonly used. A few studies, predominantly in the critical care setting, have suggested that the posterior approach for central lines is equivalent or better in comparison to the conventional central approach.^[1-3] However, there are no studies to validate this observation in patients needing IJ catheter insertion for the purpose of HD.

Materials and Methods

All patients requiring IJ catheterization for HD, during a 1-month period were included in the study. After obtaining an informed consent, a total of 104 patients were included in the study. They were randomly assigned to undergo IJ catheterization via either central approach or posterior approach. Both groups had patients with a similar demographic and clinical profile with similar

Address for correspondence:

Dr. M. Mathur,
Department of Nephrology, SMS Hospital and Medical College,
Jaipur, Rajasthan, India.
E-mail: mathur_medico@yahoo.co.in

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etiologies for renal failure. Fifty-four patients were assigned to the central group and 50 patients were assigned to the posterior group. The catheters used in this study were uncuffed and temporary catheter.

A double lumen, 11.5 Fr-curved extension HD catheter (DiaX HD catheter/length – 13 cm), along with a 18 G cm × 7 cm introducer needle and 0.035" × 70 cm J' tip guidewire was used for catheterization. The central approach entails cannulating the IJ vein at the apex of the selidotts triangle, formed between the two heads of sterno-cleido-mastoid (SCM) and clavicle inferiorly.

In the posterior approach, the point of needle insertion is along the lateral edge of SCM muscle, cephalad from the point in which the external jugular vein crosses the muscle [Figures 1 and 2]. The direction of needle is medially toward the suprasternal notch (jugular notch). After cannulating the vein, the HD catheter is mounted over a guidewire using the Seldinger's technique in both approaches. The tip was attempted to be placed at the carina/right tracheobronchial angle, however, it may not be possible to achieve this position, especially in taller individuals and also if they happen to have catheter inserted through posterior approach. This is because the length of catheter selected is fixed at 13 cm. It is to be noted that too much high position in the SVC will give

higher flow problems and increase the risk of central venous stenosis if the catheters are kept for a longer duration.

The patients were followed-up till the HD catheters were removed. The mean duration of IJ catheterization was 13.5 days in central group and 10.25 days in posterior approach group. The various outcomes like procedure-related complication rate (carotid puncture, pneumothorax, etc.), catheter insertion failure rates, that is, need for more than 3 attempts to catheterize or total failure of catheter insertion, interruptions during HD due to obstruction in blood flow and infection rates were collected in both the groups and analyzed. All analyses were performed using SPSS software, version 18 (PASW Statistics for Windows, SPSS Inc, Chicago). A result was considered significant if its probability of occurrence by chance was <5% ($P < 0.05$).

Results

The results are shown in Table 1. In the central approach group, 32 patients (60%) had chronic kidney disease (CKD) and the rest, had acute kidney injury (AKI). In the posterior approach group, 35 patients (70%) had CKD and the remaining 20 patients (40%) had AKI.



Figure 1: Anatomical landmarks in internal jugular vein insertion by posterior approach. Red line indicating external jugular vein. Note the angle of syringe pointing towards the suprasternal notch

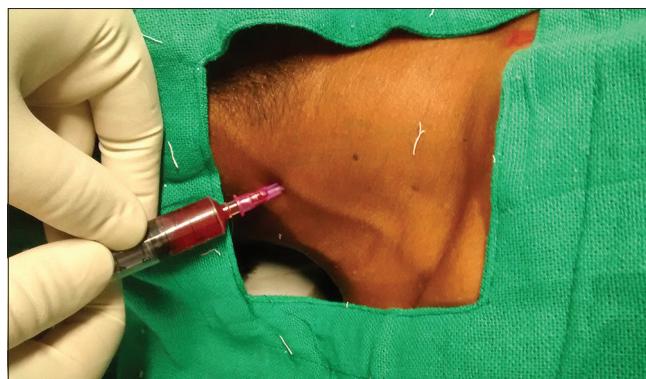


Figure 2: Needle entering the internal jugular vein just above the junction of posterior aspect of sterno-cleido-mastoid muscle and the external jugular vein

Table 1: Outcomes of patients between anterior and posterior approach for internal jugular HD catheter

Outcome	Anterior approach group (n=54)	Posterior approach group (n=50)	P
Complications related to procedure			
Carotid puncture	7	3	0.04
Pneumothorax	1	0	
Total	8 (14.81)	3 (6)	
Catheter insertion failure rate			
Need for >3 attempts	5	4	0.07
Failure to insert catheter	2	6	
Total	7 (12.96)	10 (20)	
Interruptions in HD flow	9.25%	46%	<0.01
Catheter infection rate	9 (16.66)	7 (14)	0.75

HD: Hemodialysis. Figures in parentheses are percentages

The incidence of carotid puncture and pneumothorax was higher in central approach group when compared with posterior approach group. The difference was statistically significant ($P < 0.05$). The posterior approach was associated with higher HD catheter insertion failure rate; however, this difference was not statistically significant ($P > 0.05$). Interruptions in HD flow were more frequent in the posterior approach group. Most often the interruptions were associated with total cessation of blood flow or blood flow of <200 ml/min. In both situations, manipulation of the catheter or the position of the patient's neck would result in normal blood flow. The rate of interruption in blood flow was significantly higher in patients with posterior approach group ($P < 0.01$). Catheter infection manifesting as any combination of fever, leukocytosis, exit site discharge, metastatic infection with or without blood culture was seen equally in both groups.

Discussion

The IJ vein can be cannulated via three approaches viz., anterior, central and posterior.^[4] The central approach is most commonly used; the other two approaches are seldom used. The posterior approach used in this study was described by Brinkman and Costley (high lateral approach).^[5] There is no study comparing the outcomes of HD catheter insertion via the different approaches. A few studies have compared the two approaches for IJ catheterization. In these studies, the authors concluded that posterior approach was a safe and equivalent option.^[1-3] However these studies were conducted in ICU setting. This may not be applicable to the insertion HD catheters because the purpose of IJ cannulation in ICU is predominantly for administration of medications and hemodynamic monitoring. This entails using a catheter with much smaller caliber than a conventional HD catheter; moreover the blood flow rates are very high in HD catheters, which would be strongly influenced by the local vascular anatomy. Hence in this study we have tried to address the issue of preference between the two approaches in inserting IJ catheters for the purpose of HD.

We found that the posterior approach was more suitable in cannulating obese patients with short necks, patients with goiter etc., because in anterior approach, palpation of the landmarks, that is, the heads of the SCM is difficult and if carotid pulsations are not palpated gently, the anatomy of the neck can be distorted and hence results in accidental carotid puncture by anterior approach. In contrast to this, the posterior approach needs identification of only the main bulk of the SCM muscle.

The external jugular vein, which was the other landmark, could be identified easily by the Trendelenberg position. This is reflected by the lower procedure-related complication rate in the posterior approach.

As seen in the results, posterior approach was associated with significantly higher rates of flow obstruction. This could possibly be due to kinking of the catheter due to increased angulation of the catheter. The other possibility is that it could be similar to the "pinch off" phenomenon seen in sub-clavian catheters.^[6] In sub-clavian catheters, it occurs due to obstruction of the sub-clavian catheter between first rib and the clavicle. The pinch off phenomenon is known to cause obstruction in flow or even breaking off sub-clavian catheters.^[7,8] There is a possibility that in the posterior approach the HD catheter, by virtue of it being of larger caliber, gets kinked between the posterior aspect of the clavicular head of SCM and the transverse process of the cervical spine. This worsens when the patient straightens his neck. However this remains conjectural at present. The frequent interruptions can result in inadequate dialysis and also clotting of the dialyser, hence is a significant disadvantage of using the posterior approach. Another possible complication due to kinking could be increased rates of hemolysis, although it was not seen in our study.

The posterior approach can be utilized in certain specific scenarios. For example, in patients with local exit site infection from a pre-existing IJ HD catheter Figure 3, posterior approach can be used as an alternative. This obviates the need to use left IJ vein or femoral vein for catheter insertion, which is the usual practice. In our study, among the 50 patients in the posterior approach group, 3 (6%) had evidence of local exit site infection

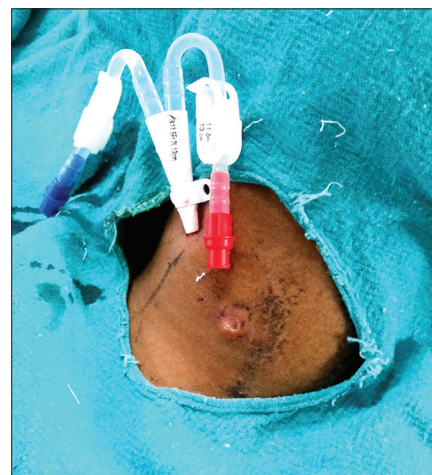


Figure 3: Hemodialysis catheter inserted via the posterior approach. Note the local exit site infection from the previous catheter inserted via central approach

from previous HD catheter insertion by central approach. We were able to successfully cannulate the IJ vein via the posterior approach. Since a totally different site is used for HD catheter insertion, there is very less chance of re-infection of the HD catheter.

Occasionally, in failed attempts to catheterize IJ HD catheter, the local anatomy gets distorted due to extravasation of blood. This precludes further use of this site for HD catheter insertion. The usual practice is to cannulate the left IJ or femoral vein for HD catheter insertion. However in our experience, posterior approach was used successfully in cannulating IJ vein in most of these patients. It is because the distorted anatomy due to extravasation of blood is usually localized anterior to the clavicular head of SCM, hence the local anatomy of the IJ is usually well maintained and can be used for cannulation.

The distinct advantage of using the posterior approach in the above scenarios is that it obviates the need to cannulate left IJ, femoral vein or sub-clavian vein for HD catheter insertion.

Conclusions

Posterior approach for IJ HD catheter insertion is a safe procedure; however, this approach has higher rates of catheter insertion failure rates and significantly higher rates of interruptions in HD due to obstruction in blood flow. Repeated interruptions in HD may lead to inadequate dialysis dosing, clotting of the dialyzer and possibly hemolysis. The posterior approach can be

used in patients with local exit site infection or in failed attempts to cannulate IJ vein via the conventional central approach. The infection and complication rate were similar between the two approaches. Hence, overall the central approach is still the preferred approach for IJ HD catheter insertion, but posterior approach is a reasonable alternative.

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